MIL-P-19644C
10 July 1970

SUPERSEDING
MIL-P-0019644B (OS)
18 July 1966, and
MIL-P-19644A
9 January 1961

MILITARY SPECIFICATION

PLASTIC MOLDING MATERIAL

(POLYSTYRENE FOAM, EXPANDED BEAD)

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope - This specification covers shapes formed from expandable bead or pellet polystyrene and the general requirements for both the material and the shapes. (See 6.3.1)

1.2 Classification - Shapes furnished under this specification shall be of the type and class of polystyrene material specified on the appropriate drawings. Both type and class shall be specified by the procuring activity.

1.2.1 Types

1.2.1.1 Type I-Non Fire-retardant - Polystyrene material for which fire retardance is not required.

1.2.1.2 Type II-Fire-retardant - Polystyrene material especially formulated to be "non-burning" "self-extinguishing" or "fire-retardant".

1.2.1.3 Type III - Oil resistant - Polystyrene material especially formulated to be oil and grease resistant.

1.2.2 Classes

1.2.2.1 Class 1 - Polystyrene material which is natural (white) in color.

1.2.2.2 Class 2 - Polystyrene material colored a specified color uniformly throughout.

FSC 9330

1.2.2.3 Class 3 - Polystyrene material which is essentially natural in color but which contains approximately 3 percent of individually colored beads scattered at random throughout.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on the date of invitation for bids or request for proposal form a part of this specification to the extent specified herein:

SPECIFICATIONS

Federal

H-B-621F	Brush, Stencil

Military

JAN-T-171	Toluene
MIL-L-6082	Lubricating Oil, Aircraft Reciprocating (Piston) Engine
MS 36030	Carbon Tetrachloride, ACS
OR-11	Developement of Packaging, Handling, Storage and Transportation Systems for Weapons

STANDARDS

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage

(Copies of documents, other than specifications and standards, required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Specifications and standards are available from the U.S. Naval Publications and Forms Center, 5801 Tabor Ave., Phila., Pa. 19120.)

* 2.2 Other publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

American Society for Testing and Materials

D-1622	Apparent Density of Rigid Cellular Plastics
D-1692	Flammability of Plastic Sheeting and Cellular Plastics

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103)

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

Central Scientific Company

78640	Catalog

(Application for copies should be addressed to the Central Scientific Company, 2600 South Kestner Avenue, Chicago, Illinois 60623.)

Kiethley Company

Static Meter Model 600A
Catalog

(Application for copies should be addressed to the Kiethley Company, 28775 Aurora Road, Cleveland, Ohio 44139.)

3. REQUIREMENTS

3.1 Material - Cellular polystyrene shall consist of polymerized styrene expanded many times in volume. It shall be formed by the expansion of high density beads or pellets by application of heat and pressure. Expansion and fusion of beads or pellets may be made to occur in a series of steps or in a single step as required.

3.2 Uniformity - The expanded polystyrene material shall be homogeneous and

uniform in composition. It shall contain no large openings, accumulations of unexpanded resin, inclusions (except as specified) or tears. The surface skin or rind shall be essentially smooth and free from voids or blowholes.

3.3 Color - The color of the finished shape shall be as specified in class requirements.

3.4 Odor - Shapes furnished by the supplier shall be free from any enduring objectionable odor.

3.5 Inclusions or application - Unless otherwise specified, materials shall be included in, or applied to, the surfaces of formed shapes for the control of static electricity or the reduction of friction or both. The materials and amounts to be included or applied shall be as specified.

3.6 Toxicity - The material furnished in the finished items (see 6.3.1) shall be non-toxic except for recognized toxicity value of materials included or applied (3.5).

3.7 Density and dimensions - The density and dimensions of items furnished shall be as specified on appropriate drawings and tolerances for density shall be within specified limits.

3.8 Physical property values - Unless otherwise specified, the formed shapes shall comply with the physical property requirements of table I.

* Table I.-Physical and Chemical Requirements

Property	Value Required			
Apparent Density per cu. ft. (PCF)	1 ± 0.15	2 ± 0.15	3 ± 0.20	4.5 ± 0.20
Tensile Strength PSI, ULT., MIN.	See 4.3.4			
Impact Strength	See 4.3.5			
Compressive Strength PSI, ULT., MIN.	8	25	40	70
Water Absorption lbs. per sq. ft. MAX	0.12	0.12	0.12	0.12
Compression Set, %, MAX.	4.0	3.5	3.3	3.0
High and Low Temperature and Humidity	Material must withstand and function after specified exposure.			
Oil Resistance (Softening)	Shall not soften			
Static Electricity (see 3.5) (KV, MAX)	2.0	2.0	2.0	2.0
Flammability According to Type Requirements	ASTM D-1692 (3.13 and 4.3.11)			
Moisture %, MAX	0.4	0.4	0.4	0.4

*3.9 Tensile strength - The minimum value for tensile strength shall be expressed as PSI, ULT, on the applicable drawing (see 6.2).

*3.10 Impact - The individual container shall withstand prescribed drop and impact tests without allowing exposure or spillage of contents. The configuration and weight of contents shall be specified on the applicable drawing (see 6.2).

*3.11 High and low temperature exposure

3.11.1 High temperature - The container shall be conditioned at +160°F with a relative humidity of 95 percent, allow to come to equilibrium (approximately 4 hours) and shall meet the impact requirements of 3.10.

3.11.2 Low temperature - The container shall be conditioned at -65°F, allow to come to equilibrium (approximately 4 hours) and shall meet the impact requirements of 3.10.

*3.12 Oil resistance - The material, after being submerged in lubricating oil for a minimum period of 70 hours, shall not soften or show visible signs of swelling.

*3.13 Flammability (According to type requirements) - The material, according to type, shall be "non-burning". self-extinguishing" or "fire-retardant".

4. QUALITY ASSURANCE PROVISIONS

*4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Sampling

4.2.1 Inspection lot - For purposes of sampling a lot shall consist of all material of one type manufactured at the same time, using material from one production batch, of one density and configuration, in the same production run, and offered for delivery at the same time. Inspection shall be in accordance with MIL-STD-105, according to levels specified on appropriate drawings.

4.2.2 Samples - A sample unit shall consist of sufficient material to produce three specimens each for the specified tests. These specimens shall be tested for conformance to the property requirements of Section 3, in accordance with the procedures of 4.3. Lot acceptance shall be based on conformance with all test requirements listed in the contract or order and applicable drawings.

4.3 Test procedures

4.3.1 Specimens - When necessary, finished shapes shall be sectioned to provide specimens appropriate for the performance of tests.

*4.3.2 Conditioning of specimens - Unless otherwise specified, all tests shall be conducted at a temperature of 23 ± 1.1°C (73 ± 2°F) and 50 percent relative humidity.

*4.3.3 Density - The apparent density of the material shall be determined in accordance with ASTM D-1622.

4.3.4 Tensile strength

4.3.4.1 Specimens - If the item supplied is a container, the complete container shall be the specimen. A minimum of seven days shall have elapsed from the time of forming and no condensate shall be visible on the article to be tested. If the shape supplied is not a container, an alternate method shall be stated in the procurement documents.

4.3.4.2 Test fixtures - In the performance of this test, steel plates shall be cut to fit against and parallel to the areas of the container which are to be tested. The steel plates shall be of sufficient thickness to prevent bowing or bending and shall be free from burrs and sharp edges. A 7/16-inch hole shall be drilled in the approximate center of each plate perpendicular to the faces of the plate. Two 3/8-inch diameter steel rods about 12 inches long shall be prepared by modifying one end of each rod such that it will be accepted and held in the clamping jaws of a tensile test machine. The opposite end of each of the two rods will be fitted with and attached to a one-inch diameter 1/4-inch thick steel plate to prevent complete passage of the rod through the pulling plate. A tensile-strength machine (Scott Model Q or equal) providing a 20 ± 1 inch per minute speed shall be used.

4.3.4.3 Procedure - Place one of the pull plates against and parallel to the surface which is to be tested. Using an appropriate size cork borer or a small electric drill with a 3/8-inch metal drill bit, carefully drill a hole through the section of material using the pulling plate as a guide. Modification

of the container such as drilling of holes for attachment rods shall not weaken the container. The opposite end or side of the item to be tested is prepared in a similar manner. Place the pulling plates inside the sections to be tested, insert rods through plates and material and attach to the tensile strength machine (see figure 1). The attachment of the component to the tensile machine and the surface to be tested shall be detailed in the documentation for the item. Attachment of the plates shall be parallel to the surface of the container that is pulled. The container shall be pulled to the point of failure and the results (in pounds) shall be reported. Thus the tensile strength will be a function of the cross-sectional area (including the skins) of the particular design and is not necessarily directly related to the strength of another design.

4.3.4.4 Value required - The minimum acceptable value shall be stated on the appropriate drawing.

4.3.5 Impact and drop test

4.3.5.1 Specimens - If the item supplied is a container, the complete container shall be the specimen. In other cases an alternate method shall be specified in procurement documents.

4.3.5.2 Procedure - Loaded containers with actual or simulated contents shall be tested in accordance with OR-11, developement of packaging handling storage and transportation systems for weapons.

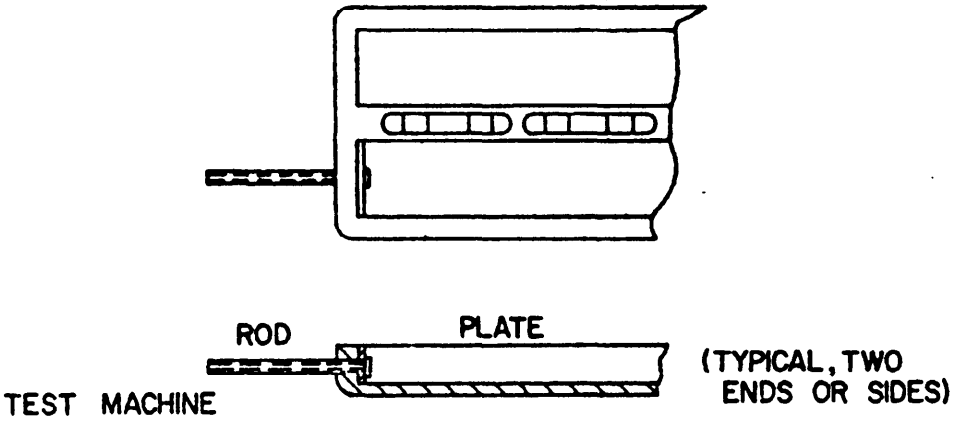
4.3.6 Compressive strength

4.3.6.1 Specimens - Three specimen pieces 6 by 6 inches by 1 inch shall be cut from material from each sample unit. If specimens of this size can not be obtained an alternate size will be stated on the drawing.

4.3.6.2 Procedure - Individual specimens shall be placed between the platens of a standard compression testing machine and subjected to a gradually increasing load, at a platen speed of 0.05-inch per minute, applied uniformly to the 6 by 6 inch faces of the material. The loading shall be continued until a point of failure indicated by a crush or break, or until the specimen is compressed 25 percent of the thickness of the original specimen, whichever occurs first. Load in pounds per square inch and percent compression shall be noted.

4.3.7 Water absorption

4.3.7.1 Specimens - Test specimens shall be 4 by 4 inches square and approximately 1 inch in thickness. Other size specimens may be used when



TENSILE TEST (MODIFIED)

Figure 1

necessary. Any skin or smooth surface on the specimen shall be removed by cutting or sawing so as to provide a cellular surface.

4.3.7.2 Procedure - The specimens shall be weighed and submerged in water under a 10-foot head of water (equal to 19.05 PSIA or 4.35 PSIG), at room temperature (65° to 90°F), for 48 hours. The specimens shall then be placed in a stream of air at room temperature, for the minimum time required to remove visible water from the surface, and reweighed. The results shall be calculated as pounds of water absorbed per square foot of rind-free or skin-free surface in the plastic specimen. Three specimens shall be tested.

4.3.8 Compression set

4.3.8.1 Specimens - The compression set specimens shall be discs 1.129 inches in diameter and 1 inch in thickness.

4.3.8.2 Procedure

4.3.8.3 Thickness - Before and after the compression set test the thickness shall be measured at the center of each specimen with a dial gage graduated in thousandths of an inch and having a flat foot 1/4-inch in diameter exerting a total pressure of 3 ± 0.1 ounces. The test specimens shall be placed in an oven maintained at 140 ± 2°F and subjected to 5 PSI pressure applied by loading with a weight of appropriate bearing surface and weight. After 24 hours the load shall be removed and the sample allowed to rest on a wooden surface for 30 minutes at room temperature (65° to 90°F) before measurement of final thickness is made. The test shall be run in triplicate. The compression set shall be calculated by means of the following formula:

$$\text{Compression set} = \frac{h_1 - h_2 \times 100}{h_1}$$

Where h_1 = original thickness

Where h_2 = final thickness

4.3.8.4 Value required - Compression set values shall not exceed values in table I.

4.3.9 High and low temperature exposure

4.3.9.1 Specimens - See 4.3.5.1. If containers, load according to 4.3.5.2.

D. The panel shall be cured by placing the [illegible] in a 1/4 inch

* 4.3.9.2 Procedure - Place three specimens in an environment of +160°F with a relative humidity of 95 percent. Allow to come to equilibrium (about four hours), remove and inspect for any change in dimensions which may affect subsequent performance. Place three specimens in an environment of -65°F, allow to come to equilibrium (abour four hours), remove and inspect for change in dimensions which may affect performance. Material must be capable of withstanding and performing after being subjected to the above conditions.

4.3.9.3 Value required - See table I.

4.3.10 Oil resistance

4.3.10.1 Specimens - The test specimen shall be a disk 1.129 inches in diameter and 1 inch in thickness. Three specimens shall be prepared.

4.3.10.2 Procedure - The specimens shall be submerged in lubricating oil conforming to MIL-L-6082 for 70 hours. The specimens shall then be removed, dipped in alcohol and blotted with paper until dry.

* 4.3.11 Flammability test - The test procedures of ASTM D-1692 shall be used to determine flammability.

4.3.12 Static electricity test - This test shall be applicable only when specific measures were taken to prevent static build-up (See 3.5).

4.3.12.1 Specimen - A test for static electricity build-up shall be performed on the coated shapes when they are dry after molding. Specific conditioning may be noted on applicable drawings.

4.3.12.2 Procedure - Place the article to be tested on a non-conductive area and briskly stroke a flat surface of the article ten times with a cat skin (Central Scientific Co., Catalog No. 78640). The article being tested should not be touched or otherwise handled while the test is being run. Hold the detecting head (No. 2501) of a Keithley Static Meter (Model 600A) in such a manner that its lip is 3/8-inch from the surface being tested. The reading shall be taken from the stroked surface and shall be taken within 20 seconds after the last stroke with the cat skin.

4.3.12.3 Value required - See table I.

4.3.13 Moisture content determination

4.3.13.1 Specimens - Specimens shall be sectioned from finished articles as presented for inspection. Care shall be taken not to crush the samples (see 4.3.1).

4.3.13.2 Test apparatus - The following apparatus shall be used in this procedure:

(a) One liter cylindrical reaction flask with cover and clamp to hold. The cover shall be equipped with a ℱ 24/40 joint opening. Extra openings may be blocked with rubber or ground-glass stoppers.

(b) Heating element to fit one liter reaction flask.

(c) Distilling Receiver, Stark and Dean (or Dean-Stark tube) 10 ml. size with 0.2 ml. divisions with ℱ 24/40 joints.

(d) Water-jacket condensation tube minimum length 400 mm with ℱ 24/40 joints.

(e) Drierite-glass wool filled drying tube with rubber stopper to fit end of condensation tube.

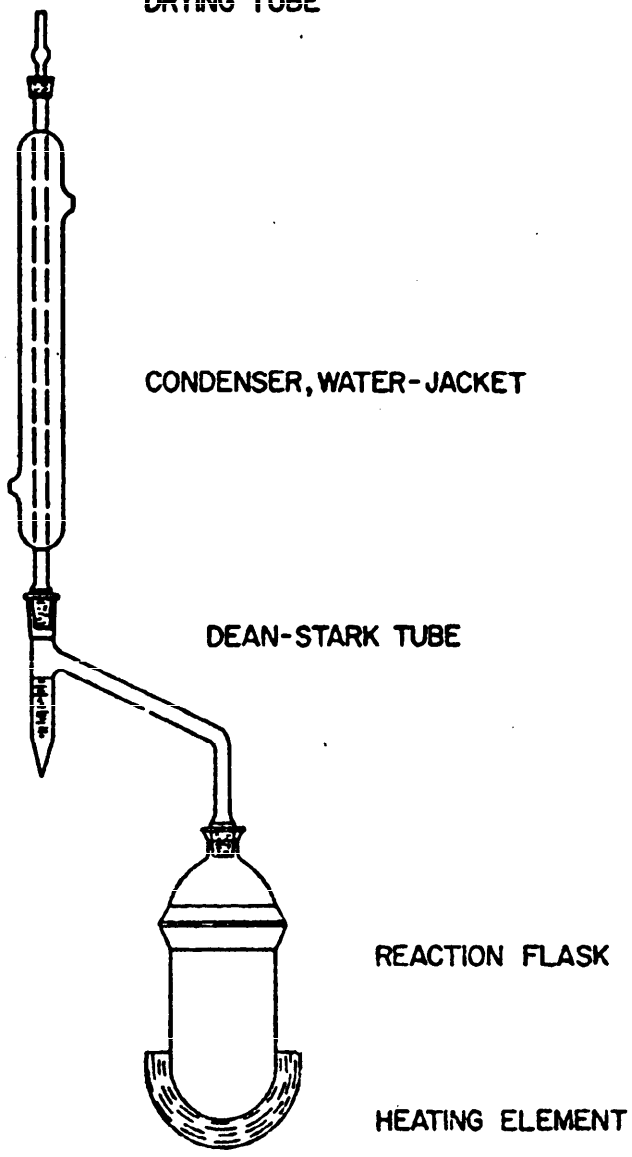
The above apparatus shall be set up as shown in figure 2.

4.3.13.3 Reagents - Toluene, commercial grade, JAN-T-171, Grade B, Specific Gravity 0.864 to 0.874 (or carbon tetrachloride MS36030). Either toluene or carbon tetrachloride shall be used throughout entire procedure but shall not be mixed.

4.3.13.4 Procedure - About 50 grams (weighed to nearest 0.1 gm) of specimen are weighed into the well-dried one liter flask. Three hundred ml. of toluene (or carbon tetrachloride) and a few boiling chips are added to the flask which is then fitted into place. Apply heat and reflux the solution until the water has all been trapped in the Dean-Stark tube. When the water level maintains a constant maximum level for 15 minutes, the system is allowed to cool and about 20 ml. of toluene (or carbon tetrachloride) are poured down the condenser to rinse any water droplets into the Dean-Stark tube. The tube is then removed from the system, its contents stirred to assure complete separation of the toluene (or carbon tetrachloride) and water and the volume and temperature of the water are recorded. The percent moisture shall be calculated as follows:

$$\text{Percent Moisture} = \frac{\text{Volume } H_2O \times \text{Density } H_2O \times 100}{\text{Sample Wt.}}$$

Duplicate distillations shall be run.



MOISTURE DETERMINATION APPARATUS

Figure 2

4.3.13.5 Value required - See table I. In addition, articles furnished shall be free from visible condensate inside and outside.

4.3.14. Integrity of structure - Shapes furnished under this specification shall be tested for quality of bead fusion as indicated below.

4.3.14.1 Procedure - Score the shape (both sides of the section representing the approximate thickest section of the shape) the minimum depth necessary to allow it to be broken by hand pressure, or by similar means, and break into two parts. Retain any discrete beads loosened by fracturing. Then, over the fractured surfaces by use of a brush conforming to H-B-621F, and under normal painting pressure, subject all fractured areas to a reciprocating stroke. Retain all released discrete beads. Count all beads and calculate the number of beads per 100 square inches of surface area. Defectives are shapes that release more than 12 beads per 100 square inch area.

4.2.15 Other tests - Supplied shapes or material may be expected to meet the requirements of other tests indicated in the contract or order and/or on the appropriate drawings.

5. PREPARATION FOR DELIVERY

5.1 Packing

5.1.1 Level C - For domestic shipping immediate use: The material shall be prepared for shipment to insure carrier acceptance and safe arrival at destination. Containers, if used, shall conform to the Uniform Freight Classification Rules or other carrier regulations applicable to the mode of transportation.

5.2 Marking - In addition to any special markings required in the contract or order marking for shipment shall be in accordance with MIL-STD-129, (except that in carload or truckload lots, approximately 5 percent of the units shall be marked. The marked units shall be located in, or adjacent to, the doorways or entrances of the railroad car or truck. A tally card shall be secured in a prominent accessible location adjacent to the doorways of the car to facilitate checking the contents during the unloading).

6. NOTES

6.1 Intended use - The finished shapes covered by this specification are intended to be used in applications where lightweight, medium crushing strength, durability,

resistance to weathering and possible contact with oily materials are required. Specific applications will be packaging and similar applications. Temperature for continuous usage or storage of the expanded material should not exceed 165°F or less than -60°F.

*6.2 Ordering data - Procurement documents should specify the following:

(a) Title, number and date of this specification

(b) Type and class (see 1.2)

(c) Physical property values (see 3.8 and table I)

(d) Size (see 3.7)

(e) Tensile strength (see 3.9)

(f) Impact (see 3.10)

(g) High and low temperature exposure

(h) Oil resistance (see 3.12)

(i) Coating for control of static electricity (see 3.5)

(j) Density (see 3.7)

6.3 Definitions - As used herein the following definitions should apply.

6.3.1 Shapes - In most cases, shapes should be considered as container parts, spacers, or dunnage materials. The word "item" shall be a direct substitute for "shape" with the same meaning.

6.3.2 Specimen - A specimen shall be a sample or necessary part of a sample to be used for test purposes in a specific test.

6.3.3 Sample - A sample shall be that number of items necessary to perform the entire plan of testing for acceptance of each lot of items submitted.

* 6.4 Changes from previous issue - The outside margins of this document have been marked "*" to indicate where changes (deletions, additions, etc) from the previous issue have been made. This has been done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirement

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